A colinear antenna for repeaters

by J. A. ROLLASON, G3WCO*

THE antenna to be described was designed for transmit and receive use at the uhf repeater GB3ER. It has now been in use since October 1976 and shows no signs of degradation or change in parameters.

The author is a firm believer in efficient antenna systems for all vhf/uhf projects and has attempted to make an antenna which has narrow vertical beamwidth, approximately 12°, while having an omni-directional horizontal pattern of radiation. The gain, over 10dB, with respect to a centre-fed dipole, enables the use of low-power battery-powered transmitters and, in conjunction with a good receiver preamplifier, lets the repeater sensitivity approach that of detecting rf noise from the sun.

During the summer of 1977 good signals were received from Holland, during an opening of 10–14 days duration, and mobiles in the north, midlands and Wales have worked each other through GB3ER. The low-angle radiation and ducting provided over-the-horizon QSOs, while other repeaters in the south-east with more conventional antenna systems have not produced anything near the same dx at the same time.

Construction (Fig 1)

There is nothing particularly difficult or new, mechanically, with the construction of the antenna. All the metal is alloy tube, the dipole insulators are standard tv type, and, if it is so wished, the crossover plates and U-bolts can be replaced by tv mast clamps. However, the antenna is large, so that, if thick-walled tubes are used with the more rugged crossover plates, the antenna rigger can climb up it instead of using a ladder. Also, repeaters tend to be on high lonely places; if the antenna can be used as a ladder it will also support a lot of ice without damage.

Having finished the mechanical assembly of the dipoles and support mast, check all distances are correct to, preferably, 2·5mm (1/10in) and tighten up all nuts and bolts. Lift the assembly up horizontally on a pair of chairs so that the wiring-up task will be eased. Ten dipoles were used at GB3ER but fewer, or more, may be fitted if desired.

Each dipole is to be fed in phase if the antenna is to have gain and a beam which is at right angles to the mast (ie does not squint). There are a number of exotic methods in power distribution, (eg cosine squared, which reduces side lobes), but it was decided that since an swr meter (Bird model 43) was the only uhf test equipment available, the method of distribution and splitting, while being practical, had to be very simple to set up and to remain so. Also,

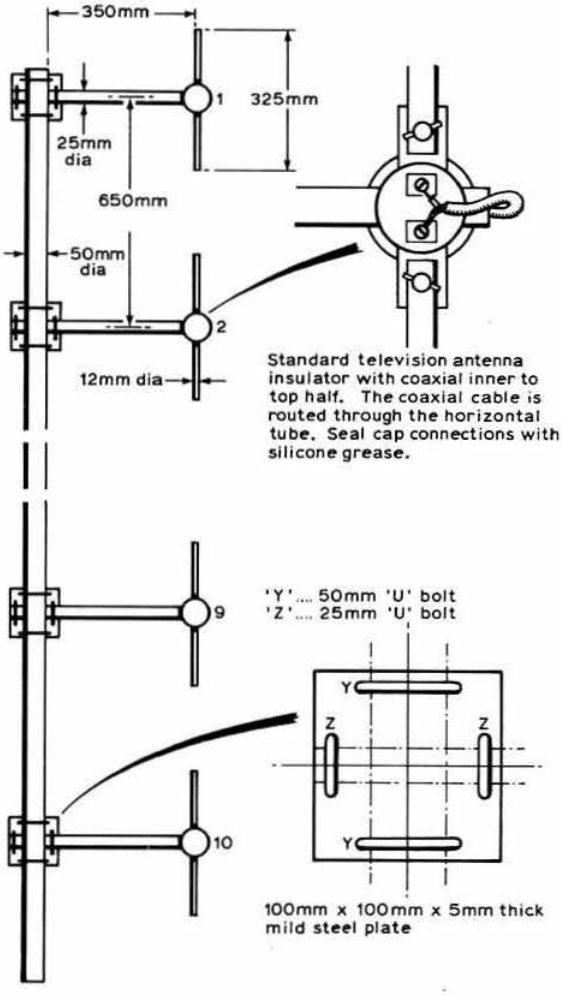

Fig 1. Mechanical details

cost had to be kept to a minimum and the whole thing had to be waterproof.

The cable feeding the dipoles is UR43 or UR76, others may work but have not been tried. It is essential that the UR76 be of good quality and it must be assumed that each feeder is identical to all the others and the same length.

Measure the distance from the top dipole insulator to some mid-point on the pole where the matching unit will be mounted. Allowing a few centimetres extra, cut 10 identical lengths of cable. Lay these out on the floor side by side and, if time permits, allow a day or two for them to shrink before proceeding further; do not stretch them in any way. After waiting, check that they are all exactly the same length and attach them to the dipoles; always connect the inner of the coaxial to the upper half of each dipole. Complete each insulator with a smear of silicone grease before replacing the pill-box lid cover. Ensure that there is no possibility of the ingress of rain into either the coaxial or dipole insulator.

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The author working on the antenna before erection

Matching unit (Figs 2, 3)

The matching unit is the heart of the design and should be carefully made; again, there must be no chance of rain getting into it.

Strip back an identical length from each feeder and, after passing it through some form of gland on the die-cast box, solder the inner to the top of the ceramic insulator, and the screen to the copper surface of the pcb material. Next make an inductor from 16swg tinned or silver-plated copper wire. The wire is 25mm long and joins the two pillars which are 20mm apart; the wire should therefore be kinked as shown. Solder the two matching capacitors as shown and, finally, bring in the UR67 tail through another gland at the opposite end of the box. Keeping the inner as short as possible, solder this to the series capacitor. Fix the matching unit on to the support mast, "behind" the dipoles, and tape all the spare coaxial to the support mast in neat lines.

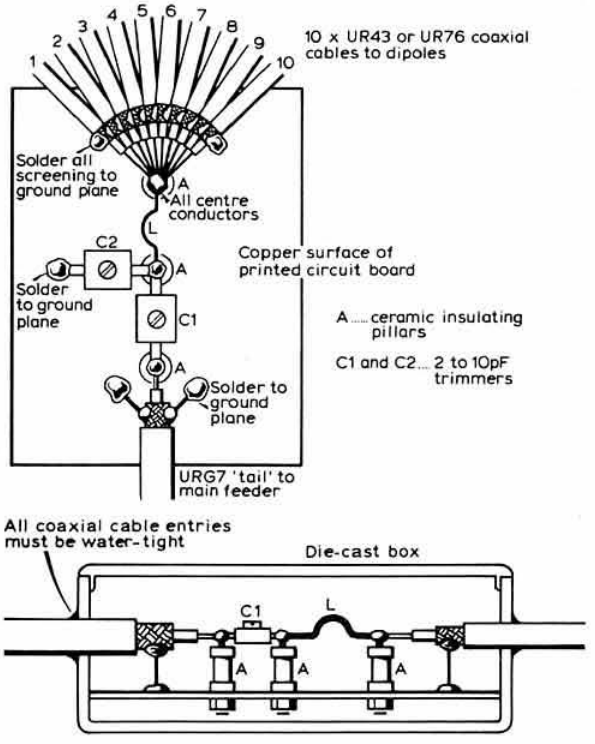

Fig 2. Matching unit layout. (Cable type described as URG7 should be UR67)

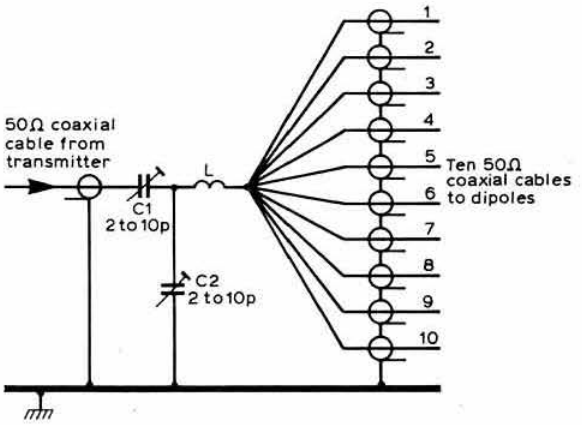

Fig 3. Matching unit circuit diagram

Setting up

Support the antenna horizontally, about 1·5m off the ground, with the dipoles pointing upwards. Connect the "throughline" (Bird model 43) between the main feeder and the UR67 tail, which could be kept to about 4m in length. Apply power to the antenna and adjust the shunt and series capacitors for zero reflected power and, of course, maximum forward power. Touching the dipoles by hand will have a slight effect on swr, but not a lot. Put the cover on the die-cast box and check that the swr is the same; if not, slightly misalign the capacitors so that the swr is correct with the lid on. The antenna system is now ready to erect. Without exotic test equipment and an antenna range there is little else that can be done to prove it works.

Mounting the antenna

At GB3ER the antenna pole was bolted to a socket which supported it, and three nylon guy ropes were attached to the top of the pole to prevent the system whipping in the wind and, hence, unwanted beam tilt. It is essential with a beamwidth of 12° to mount the antenna vertically. It was thought that the mounting pole would influence the horizontal polar diagram but in practice this does not seem to be so.

Acknowledgement

Many thanks to the Essex Repeater Group for their understanding and forbearance during the construction and erection of the antenna, which with the rest of the repeater installation was recorded for posterity on 8mm cine film by Dick Brock, G3WHR. □